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The 1979 Tornado Outbreak and Manson Storm: An Example of Tornadoes Approaching from the Northwest[1]

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It is widely believed that tornadoes move from the southwest. However, 30 percent of all Iowa tornadoes move instead from the northwest quadrant, and the majority of summer tornadoes come from this direction in the upper midwest. The greatest recorded outbreak of northwest-type tornadoes occurred on June 28, 1979, when 27 such twisters touched down in North Dakota, Minnesota, and Iowa. Ten of these were in Iowa, including the destructive Algona and Manson tornadoes. Meteorological information, satellite cloud imagery, and eyewitness accounts of the 1979 outbreak and especially the Manson storm are used here to illustrate this less-well-known class of tornadoes.

INDEX DESCRIPTORS: climatology, meteorology, tornado.

While it is commonly believed that mid-western tornadoes approach from the southwest direction, a sizable fraction of Iowa twisters move from the northwest (Spohn and Waite, 1962). Subsequent study of 386 Iowa tornadoes reported over a 13-year period (Notis and Stanford, 1973) indicated that about 3 out of 10 twisters move from the northwest. It was also learned that spring tornadoes were mostly of the "usual" type, coming from the southwest. However, during the *summer* the "northwest" tornado variety predominated. The reason for this behavior is that the air flow at high levels (20,000 to 40,000 feet altitude), which steers the parent thunderstorms, is more likely to come from the northwest during the summer months. Subsequent research has provided guidelines for forecasting tornadoes which move from the northwest (Johns, 1977).

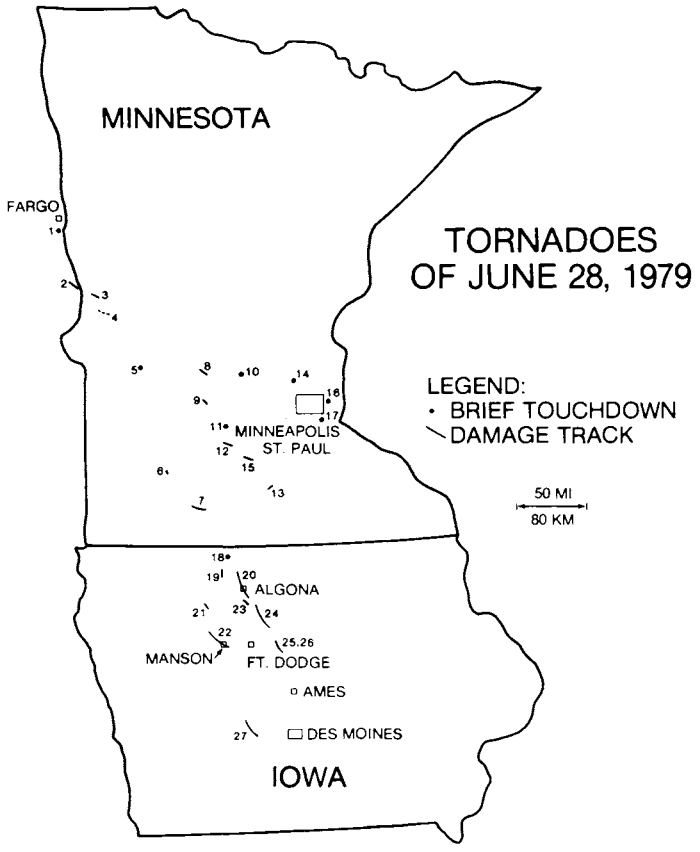

Fig. 2. Tornado occurrences on June 28, 1979 in chronological order. The general movement of the storms was from NW to SE. Tornado number 1 occurred in eastern North Dakota at 1:45 p.m. CDT and number 27 ended at 10:01 p.m. CDT west of Des Moines, Iowa.

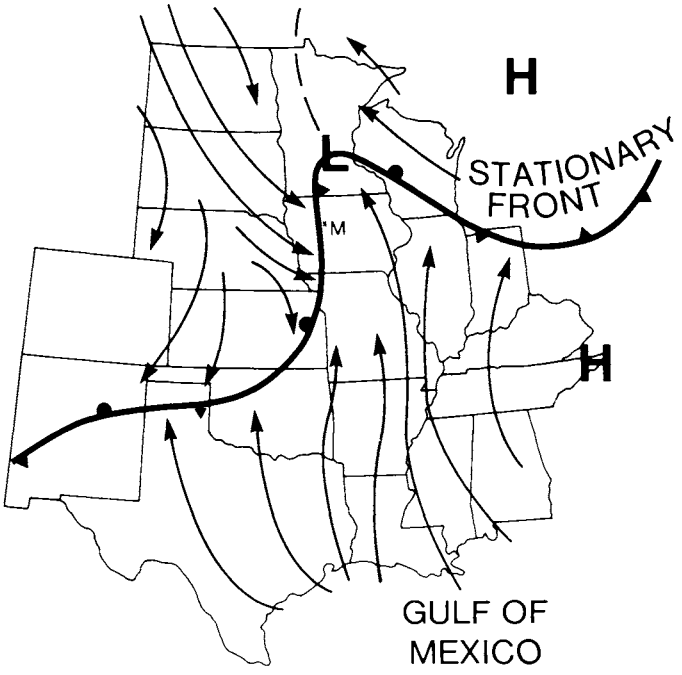

Fig. 3. Surface conditions near the time of the Manson tornado (denoted by M). The thick black line represents a frontal boundary separating different air masses. Arrows denote surface wind flow. A general cyclonic (counterclockwise) motion can be seen circling the low-pressure area (L), bringing warm, moist air (fuel for the thunderstorms) up from the Gulf of Mexico. H denotes high pressure.

[1]A preliminary version of this paper was given as part of an invited presentation at the 1981 Annual Meeting of the Iowa Academy of Science, Cedar Rapids.

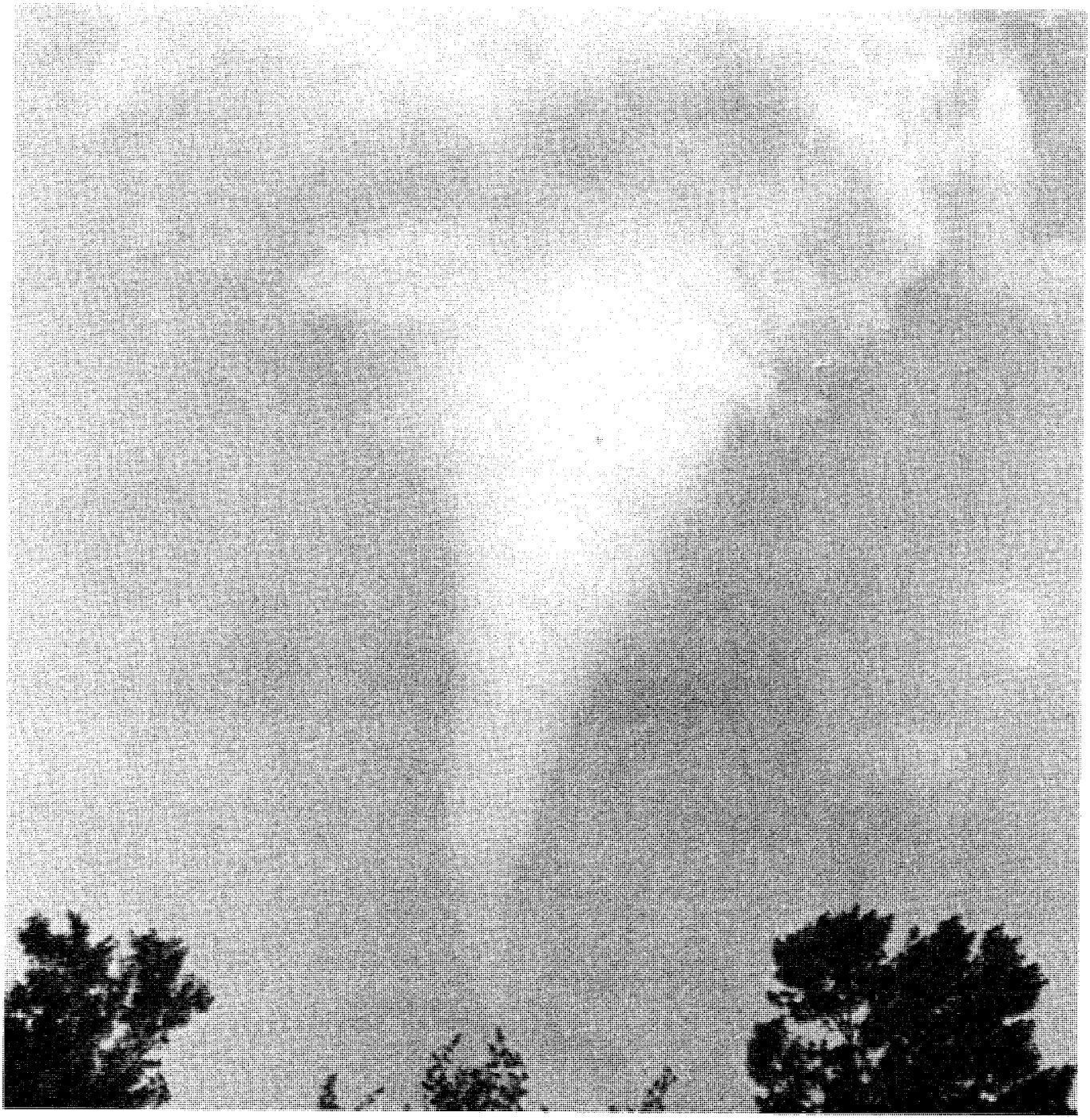

Fig. 1. The Manson, Iowa tornado, June 28, 1979. Courtesy of *Manson Journal,* photographer Rich Insko.

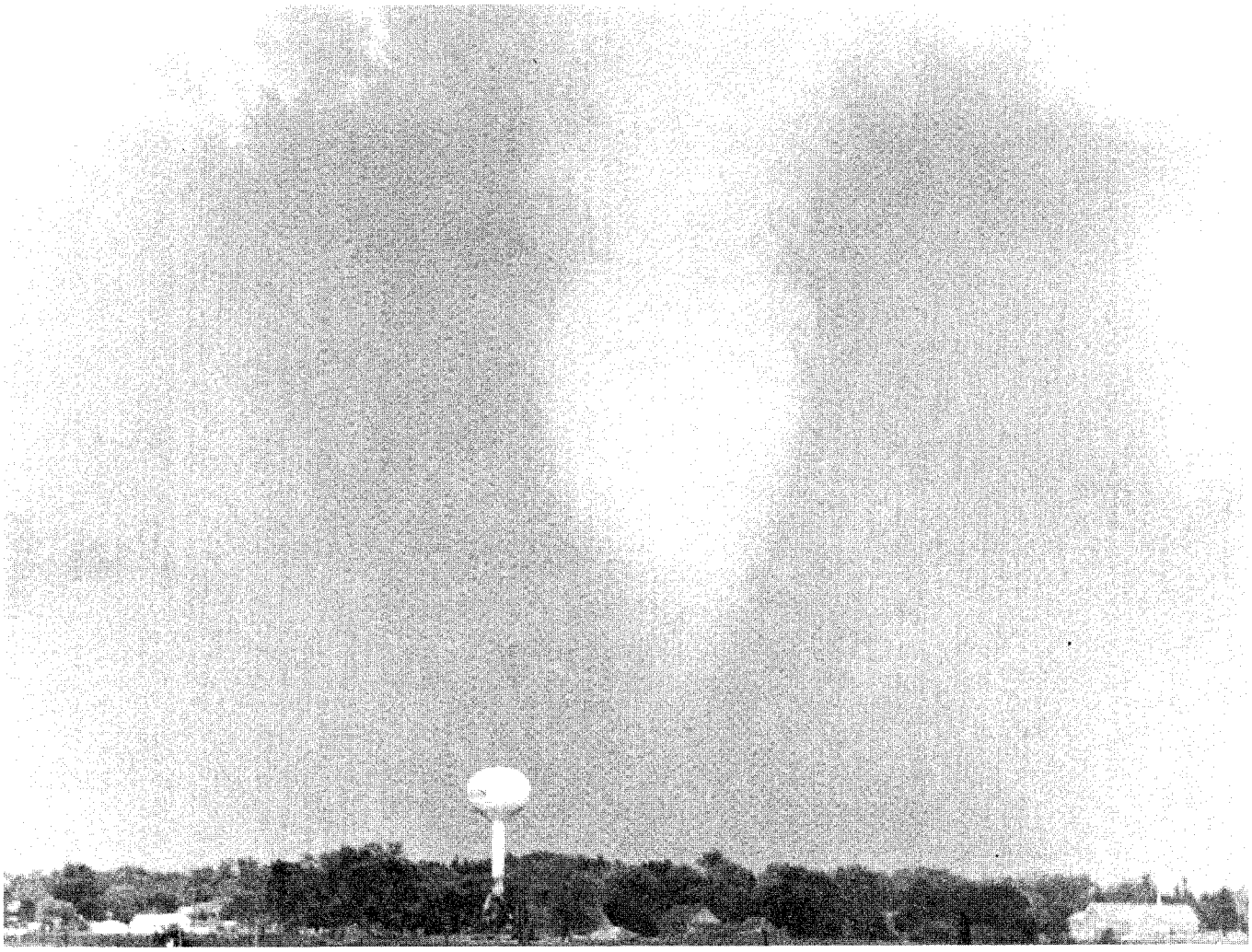

Fig. 4. The tornado leaving Manson. The water tower and buildings give both physical and personal perspective on the storm. Courtesy of *Manson Journal,* photographer Rich Insko.

The three worst tornado disasters in the history of Iowa (in terms of deaths) have all been "northwest" tornadoes: Camanche (1860), Grinnell (1882), and Pomeroy (1893).

In late June 1979, a major tornadic outbreak occurred in Minnesota and Iowa, damaging Algona and devastating Manson, Iowa. These storms were also of the "northwest" variety. In fact, the total number of twisters reported during this outbreak make it the worst on record for northwest-type tornadoes. The Manson storm (Fig. 1) was particularly destructive and closely followed the track of its famous predecessor which obliterated neighboring Pomeroy 86 years earlier.

Utilizing eyewitness accounts and photographs, weather-map information, and satellite-based cloud imagery, we use the 1979 outbreak as an example of "northwest" tornadoes in the upper midwest.

OUTBREAK OF NORTHWEST-TYPE TORNADOES

On the late afternoon of June 28, 1979, meteorological measurements revealed that the atmosphere over the upper midwest had a thermodynamically unstable structure ideal for the development of intense thunderstorms and their offspring, tornadoes. A total of 27 tornadoes were spawned in the upper midwest, including 10 in Iowa (Waite and Weinbrecht, 1980). Two of these storms caused major damage at Algona and Manson, Iowa. Fig. 2 shows the tracks of these 27 tornadoes in chronological order of their occurrence. On the following afternoon, the system had moved eastward, bringing severe thunderstorms to seven states east of the Mississippi River, and also a number of tornadoes. In this paper we focus on tornado number 22 which caused the largest number of fatalities (3), at Manson, Iowa.

Fig. 5. Tornado damage on Main Street in Manson, Iowa. Courtesy of *Manson Journal.*

Fig. 2 reveals that the general movement of the tornadoes was from northwest to southeast. The parent thunderstorms of these tornadoes were steered by upper-level winds blowing from the west northwest with moderate strength of 25-30 m/s (about 60 mph) at altitudes of 10-12 km (30,000 to 40,000 ft). Severe thunderstorms often deviate to the right of the upper-level winds and this probably accounts for the fact that a number of the longer-lived tornadoes at times traveled almost due southwards.

Fig. 3 shows the large-scale atmospheric pattern at the surface near the time of the Manson storm (denoted by M). A broad counterclockwise circulation can be seen centered around the low pressure area (L), bringing warm, moist air northward to enhance the atmosphere's thunderstorm—producing capability.

THE MANSON STORM

At 7:20 p.m. CDT a tornado touched down near Palmer in Pocahontas County, Iowa. This funnel remained on the ground for 50 minutes and traveled 30 miles. Half an hour after it began, it slowly moved into Manson, Iowa, at 7:50 p.m.

Lloyd Jones of the *Manson Journal* had intended to walk the few blocks from his home to the newspaper office at 7:30 p.m. Instead, he decided to finish reading an interesting magazine article. Had he not done so, he would have been caught in the tornado. Describing his experience Jones wrote[2]

It was 7:45 when I put the magazine down and turned off the reading light. Then my attention was drawn to the TV. Then I heard a strange sound which I recognized as the roar of a tornado. I heard one in South Dakota years ago—also from a safe distance. I looked out the window to see a massive sea of debris flying by. Stepping on to the porch the flow of material stretched as far as one could see. Green, white, brown, pieces identifiable as wood, cloth, grass, were laced together into a deep black cloud.

As I started walking downtown, it was obvious that the tornado had been closer than I had first thought. Then I noticed that the corner of Main and 11th looked very strange. Thus I was prepared somewhat for what I found.

I cannot describe my state of mind when I got to the shop. It was a two pronged one. First, that it couldn't be joined with the obvious knowledge that it was. Followed by a void. A period of dullness. Of no feeling. Then came the realization there was nothing to do but accept the obvious.

Next, I joined the throng walking the streets trying to grasp the enormity of the damage and helping assist others in locating relatives. Dale [his son] appeared and there was a moment of mutual rejoicing.

[2]Manson Journal, July 3, 1979

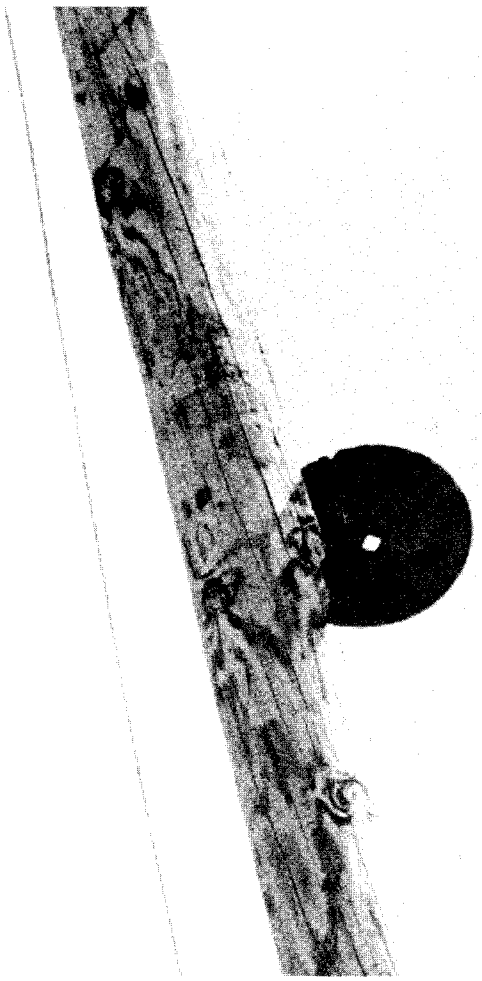

Fig. 6. A disc from farm machinery sticks out of a telephone pole. Photo courtesy of the *Manson Journal.*

The twister cut a swath of total destruction 2-3 blocks wide, from northwest to southeast, through the heart of the town of 2000 people. Afterwards, one could stand on the southeast side of Manson and look right through town towards the northwest. The devastation and destructive power of the tornadic winds was almost unbelievable, as depicted in Fig. 5-6.

THE VIEW FROM SPACE

Meteorological geostationary satellite imagery provide a unique tool for monitoring the time development of thunderstorms. Figs. 7, 8, and 9 show cloud development over the midwest at approximately four hours before, two hours before, and at the time of the Manson tornado, respectively. In Fig. 8, the white top of a tornado-producing thunderstorm can be seen half in north-central Iowa and half in south-central Minnesota. A new cell is forming at this time in west-central Iowa.

Two hours later, this cell had continued to grow and a third (perhaps double) cell had developed (near point M in Fig. 9) between the two cells in Fig. 8. It was this latter thunderstorm that spawned the Manson tornado. At the time of Fig. 9, the tornado was approaching the western edge of Manson, located by M. The general thunderstorm features shown in the satellite images, including anvil tops and bubbly-shaped updraft protrusions, are better appreciated with the help of the vertical cross-section of typical thunderstorm structure shown in Fig. 10.

Fig. 11 shows a closeup at the time of the tornado at Manson. Revealed by their shadows, bubbly tops of updrafts protrude above the relatively flat thunderstorm anvils (compare with Fig. 10). The largest anvil has dimensions of about 250 km×400 km (150 mi×250 mi) and covers an area roughly half the size of the state of Iowa.

The storm cores, indicated by the updraft tops, are near the air-mass frontal boundary which extends southwestward from the low pressure center in central Minnesota (compare Figs. 3 and 9). Inspection of cloud patterns in Fig. 9 reveals some indications of counterclockwise (cyclonic) motion around the center of low pressure in central Minnesota.

The rapidity with which a tornado-producing thunderstorm can form and produce a tornado is seen by comparing Figs. 8 and 9, taken an hour and 45 minutes apart. The middle storm in Iowa in Fig. 9 (which produced the Manson tornado at M) had not yet begun in Fig. 8. In fact, from mostly clear sky to initial tornado touchdown took less than an hour and a half for this storm.

COMPARISON WITH A FAMOUS PREDECESSOR

Because many people feel that destructive tornadoes approach only from the southwest, it is important to reiterate that many of the worst Iowa tornadoes have been of the "northwest" variety. One of the three great nineteenth century Iowa tornadoes was the Pomeroy storm which also nearly hit Manson 86 years before the 1979 storm. The Pomeroy tornado occurred on July 6, 1893 and left 80% of the town in ruins. Both storms were of the northwest type and their tracks are compared in Fig. 12.

After the 1893 storm, a Pomeroy banker by the name of Ed Masterson found a horse and started for Manson, 8 miles away. Crossing a rain-swollen creek, he fell in and swam to the other side just in time to flag a west-bound train. He convinced the division superintendent, whose special train he had stopped, that Pomeroy had been blown away. The train backed up to Manson and took on board all available help to go to the aid of Pomeroy. In 1979, helpers came from Pomeroy to aid in the clean up at Manson. Detailed accounts of the Pomeroy and other storms can be found in Stanford (1977).

CONCLUSION

Tornadoes don't always come from the southwest. In fact, in the summer months, upper-midwest tornadoes are more likely to move from the northwest and can be quite destructive. The greatest recorded outbreak of such northwest storms occurred on June 28, 1979, among which were the Algona and Manson tornadoes. In this paper we have focused on the latter event as an example of the northwest-type tornado. It exemplifies the rapidity with which a tornado can form: from cloudless, blue sky to tornado touchdown took only 1-1/2 hours. We hope this presentation will lead to increased awareness and safety during tornadic situations, particularly those in which storms approach from the northwest.

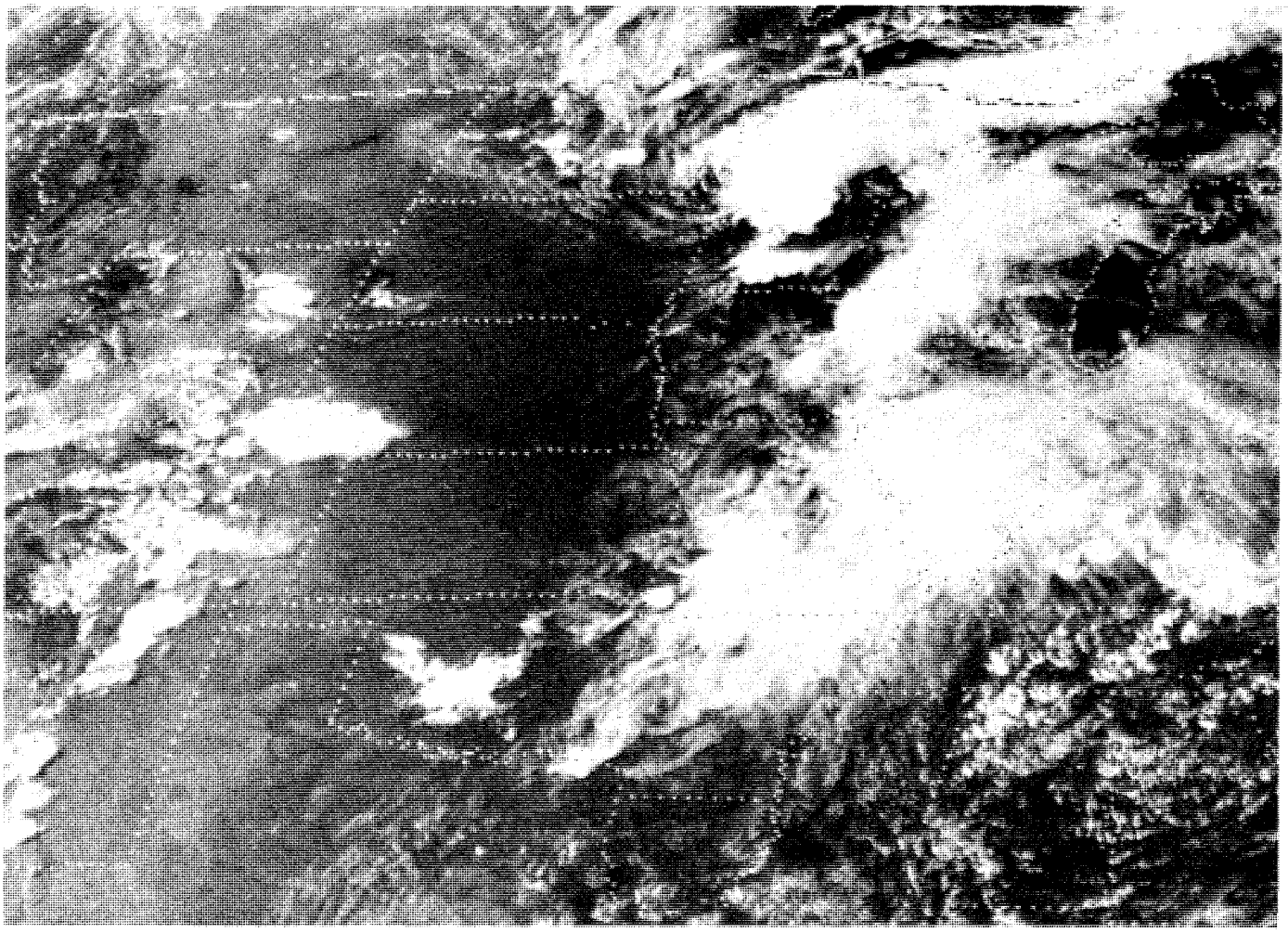

Fig. 7. Satellite view of the midwest at 4:01 p.m. CDT, June 28, 1979 (approximately four hours before the tornado struck Manson). Note clear area over northwest Iowa. Developing thunderstorms can be seen east of the Rocky Mountains. Figs. 7, 8, 9, and 11 are from National Atmospheric and Oceanic Administration geosynchronous satellite imagery.

ACKNOWLEDGMENTS

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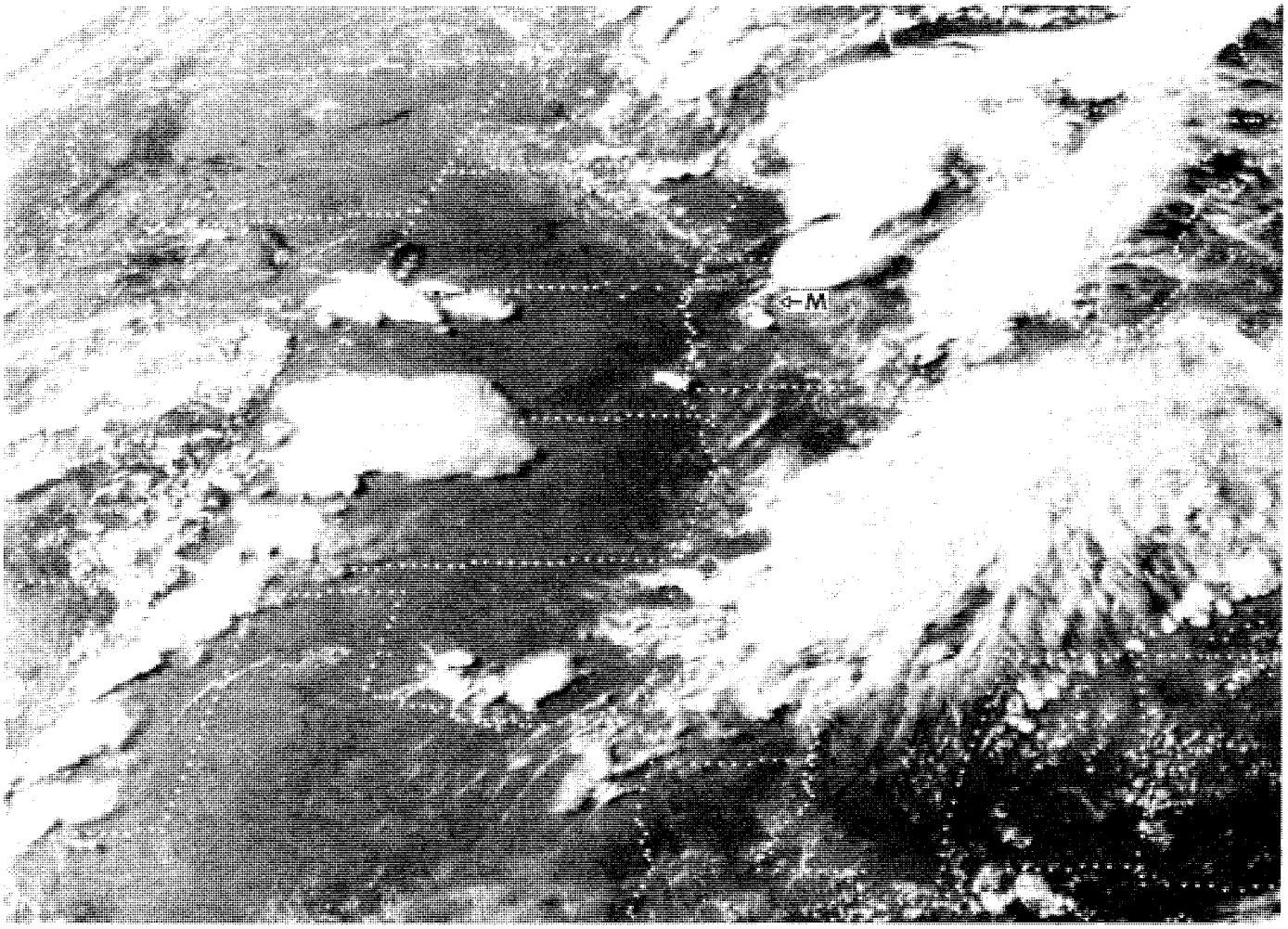

Fig. 8. June 28, 1979 satellite view of the midwest at 6:01 p.m. CDT, about two hours prior to the tornado at Manson. A large thunderstorm anvil can be seen in north-central Iowa and south-central Minnesota, with a new cell just beginning in west-central Iowa. The sky is still relatively clear at Manson (located by M).

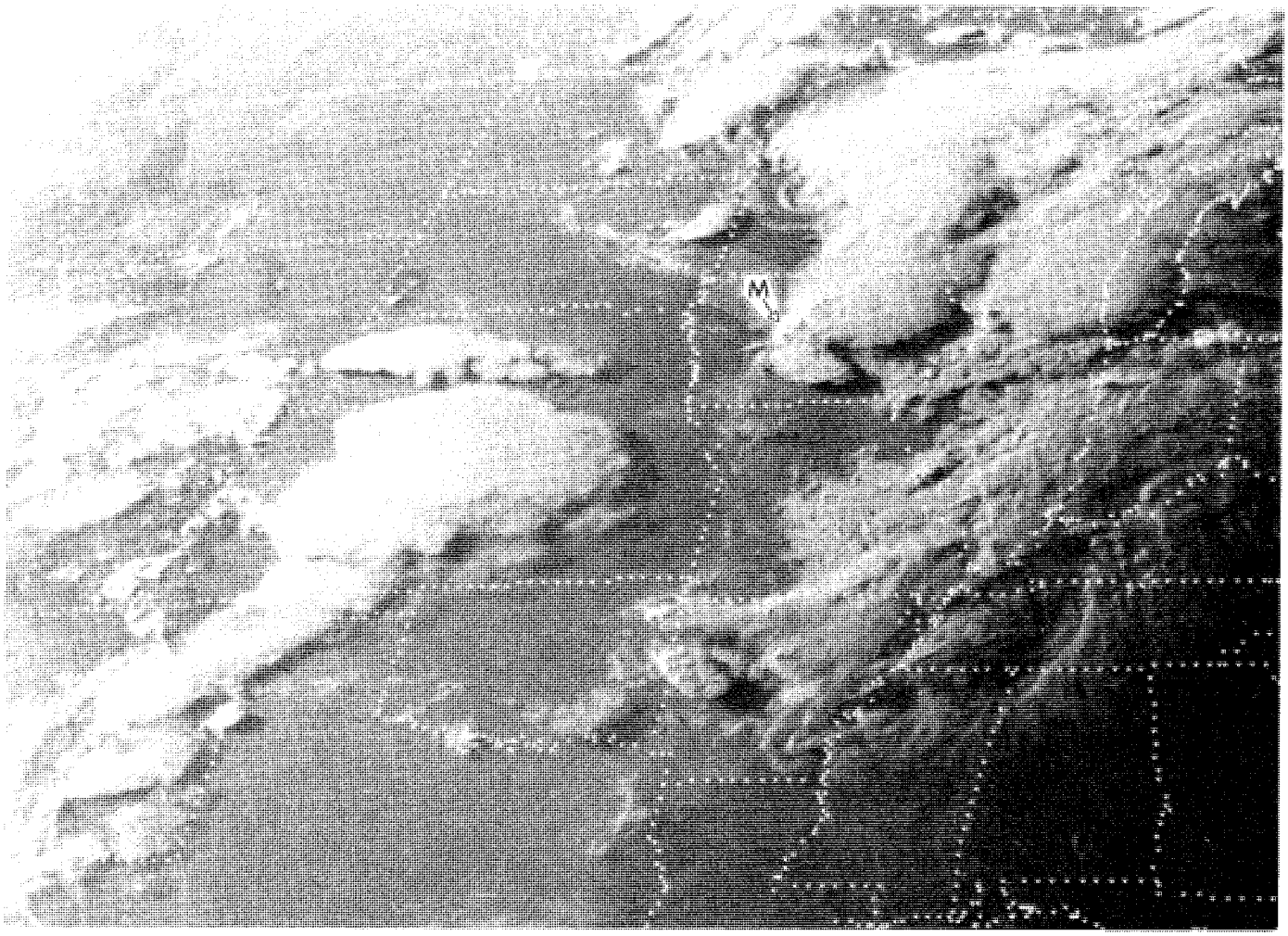

Fig. 9. At 7:46 p.m. on June 28, 1979, the Manson tornado is about to enter the western edge of town (located by M). Its parent thunderstorm is the new cell which has developed in between the two Iowa cells seen in Fig. 8. (Compare with tornado tracks in Fig. 2).

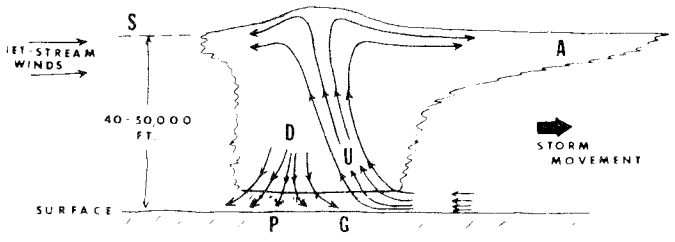

Fig. 10. Cross section of a typical thunderstorm cloud (cumulonimbus). Arrows denote wind motions. High-speed updraft column (U) acts like a chimney, carrying low-level moisture-laden air upward. The momentum of the updraft air carries it a few thousand feet into the stratosphere (S) before it sinks back down to form the mushroom-like storm cloud top. The mushroom top is then blown into the characteristic anvil shape (A) by high-level jet stream winds. The protrusion of the updraft above the anvil top often has a bubbly appearance when viewed from above, as in Fig. 11. When the downdraft (D) reaches the surface, it brings sudden gusty winds (G) and precipitation (P) in the form of rain and/or hail. From Stanford (1977), used by permission of Iowa State University Press.

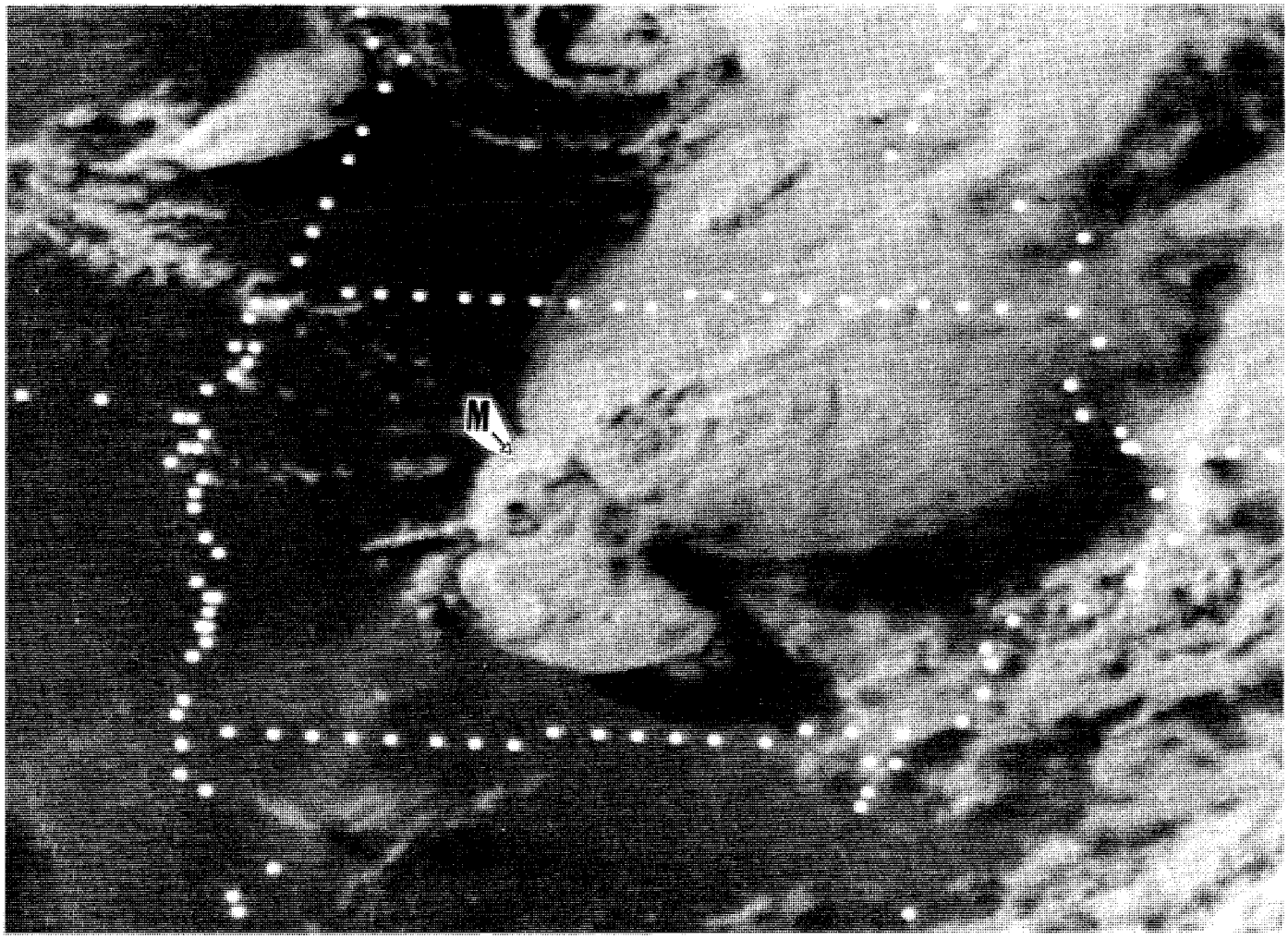

Fig. 11. An enlargement of the tornadic area in Fig. 9. Manson is located by M. Shadows reveal bubbly turrets (tops of updrafts in the thunderstorm cores) protruding above the relatively flat anvil storm tops; the shadows also lend perspective on the vast areas covered by the anvils. The central cell (at the tip of the arrow) is likely a double structure with two updrafts separated by perhaps 20 km (13 mi). The Manson tornado appears to have been near the western edge of the northern-most of the two turrets.

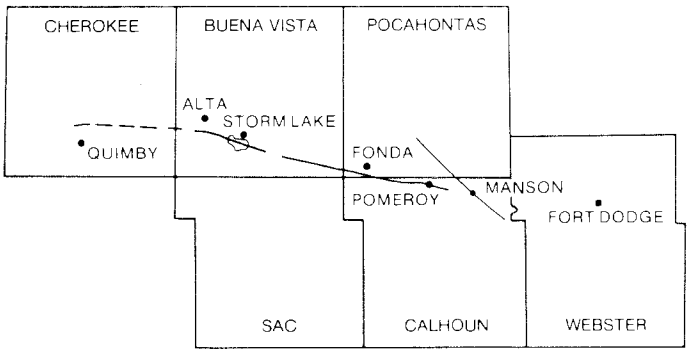

Fig. 12. Comparison of the track of the 1979 Manson tornado with that of its famous predecessor, the 1893 Pomeroy tornado. Both storms moved from the northwest quadrant. (There is evidence that storms approaching from the NW quadrant show distinctive characteristics from those approaching from the SW quadrant [Notis and Stanford, 1973]). The Pomeroy tornado is the third worst on record for fatalities in Iowa.